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Rate responses of Lyonetia speculella Clem. (Lepidoptera: Lyonetiidae) to Abamectin on Non-Bearing, Apple Trees

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Introduction

Lyonetia speculella, a leafminer, disrupts photosynthesis in leaves of young, expanding terminals. Its effect, primarily on apple, is more detrimental on young trees that have not come into bearing. In mature trees their effect is minimal because terminal growth is not as important and their are sufficient older leaves to provide photosynthate.

Within the past few years this insect has become a common pest in apple orchards throughout the mid-Atlantic States and New England with annual populations increasing at the end of the growing season.

Overwintering adult females oviposit eggs beneath the surface of the leaf in early spring. Upon hatching the first instar larvae feed in a linear, serpentine mine. After the first molt the mine becomes an irregular blotch-shape, and characteristically, this species can be identified by the constant expelling of frass beneath the leaf as it feeds. After two more molts within this blotch mine, the mature larvae emerge from the leaf and drop down to a lower leaf on a silken thread. Pupation occurs in a hammock suspended on the underside of a leaf. Several hammocks may be constructed on the same leaf.

No chemicals are registered for L. speculella at the current time. Asana has proven to be the most effective chemical control. Thiodan, Lannate, and Vydate also provided good control but did not prove to be as effective on adults (Schmitt and Hogmire, 1991).

Avermectins are a new group of compounds with much promise. Good control has been determined for a wide range of pest insects including fire ants, cockroaches, mites, leafminers (Liriomyza sp.), and psyllids. Although the precise mode of action is not well defined for the various structures of avermectins, they possess a partial systemic action within plants and break down in sunlight in a short period of time. These characteristics coupled with their broad effectiveness make them attractive compounds in IPM programs.

The objectives of this study was to determine the effect of different concentrations of abamectin (0.15 EC) on various life stages of L. speculella.

Materials and Methods

Branch terminals of newly planted, nonbearing, apple trees ('Empire', 'Golden Delicious', 'Liberty', and 'Priscilla') were studied from 5 August to 25 October when leafminers were abundant. Terminals were surveyed and chosen for testing when at least one leaf possessed either 5 linear or 3 blotch mines. An attempt was made to choose control terminals from the same tree. When it was difficult to find trees with adequate populations of leafminers terminals of adjacent trees were chosen normally within the same row.

Leaves were individually checked and the number of individuals of leafminers within each life stage was recorded. The leaf with the most abundant number of leafminers was marked with a twist-tie to be used as a frame of reference for follow-up surveys.

Prior to treatment, natural enemies observed on the terminals were removed and sleeves made of no-see-um netting were placed over the terminals to prevent reinvasion of natural enemies. Treatment concentrations of abamectin ranged from 16 to 0.5 ppm. Application consisted of dipping the leaves in a half pint ball jar containing the different concentrations. The corresponding terminal marked as control was dipped in water. After treatment the sleeves were resecured.

Terminals were checked between 2 and 5 days, 7 to 10 days, and 14 days after treatment at which time the number of individuals in each life stage were counted. Eggs were not counted after 7 days since preliminary studies indicated that hatch should occur within a week at the experimental temperatures.

Probit analysis was conducted to determine significant relationships between dose and mortality at different time periods and to estimate LD50 and LD95 concentrations.

Results and Discussion

Figures 1-7 illustrate the effect of the different concentrations on the leafminer over time. At 16 and 8 ppm there was 100% mortality before the first week (Figures 1 and 2). At 4 and 3 ppm there was survivorship at the 2 week check (Figures 3 and 4). Interestingly, development was not as rapid as indicated by the proportion of leafminers in the pupal stage after 7 days in the control versus the treated terminals. Development to the pupal stage during the 4 ppm test was probably due to inadequate treatment coverage.

With the 2 ppm treatment 100% mortality occurred prior to the two week check. Although dissimilar to what had occurred at the 4 and 3 ppm treatment, a lag time in development still existed with the greater proportion of leafminers in linear mines after 14 days for the treatment as compared to the pupal stage for the control (Figure 5). Further complicating this information was the difficulty encountered in determining whether larvae in linear mines were alive. Not until concentrations decrease to 1 or 0.5 ppm is there

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It is difficult to determine the effect Abamectin on eggs. However, there was 39% reduction in egg viability on the treated terminals as compared to 26% on the control terminals.

Percent reduction of each treatment over time is presented in Table 1. The asterisks indicate data that does not incorporate all the initial individuals. Points of interest include the amount of mortality caused by the lower concentrations. As previously stated, although development rate was similar to the control there was still a reduction in survivorship in the two treatments. Another point of interest is the relatively high mortality of the controls for the 2 and 3 ppm treatments.

LC50 and LC95 estimates are presented in Table 2. There was high control mortality and much variability in the data. Of the many factors that are important in selection of this compound the determination of the threshold level and cost of the product. In other words, the attributes of such a compound allows us to be concerned only with other factors besides degradability and effectiveness. It is worthy of note that the application method used here would probably be more effective than the normal spray procedures and practices.

With respect to the damage tolerance, it would be nice to be able to use a lower concentration to eliminate 95% of the pest in 14 days. However, too much damage might have occurred. Although precise information was not obtained during this experiment, previous studies indicate that a conservative developmental estimate for the larval stages of L. speculella in the field under a temperature range of 5-30 C is 14 days (Schmitt, unpublished). It is this particular life stage that most damage occurs and therefore it would be unwise to use a time frame much longer than even 7-10 days to achieve desired mortality.

Timing of spray is also an important consideration. Although eggs have been observed as early as mid-March, the recommendation is to spray as late as possible - only when needed. Drought or natural enemies may develop early in the season to curtail a large late season population, especially with an insect like this that has a high Economic Injury Threshold (even though we don't know what it is).

In conclusion, abamectin is a very effective compound on L. speculella. More information regarding effects on natural enemies and other pests, and field spray applications are necessary prior to implementation is needed.

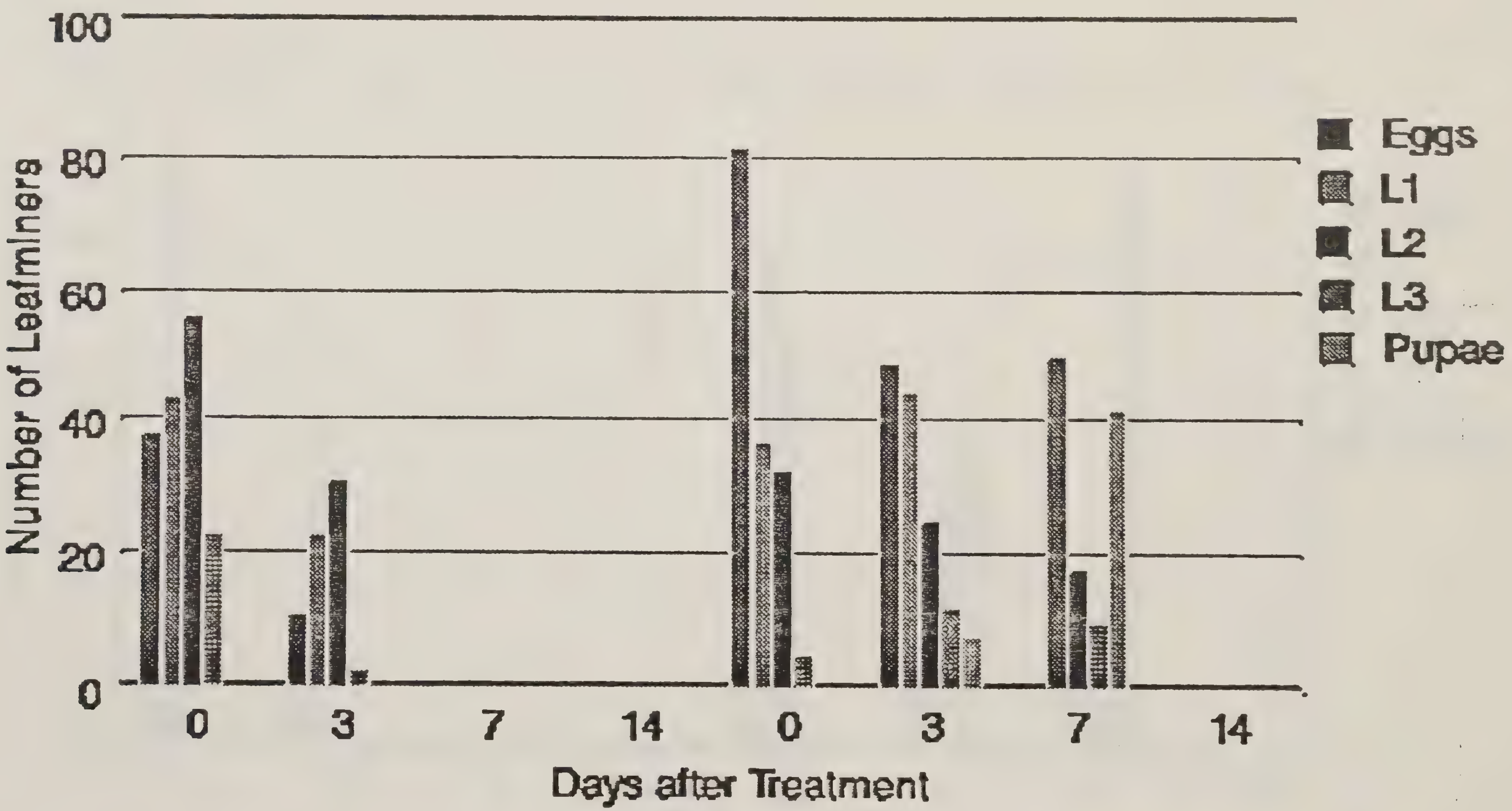

Figure 1. Effect of Agri-Mek (16 ppm) on *L. speculella* development.

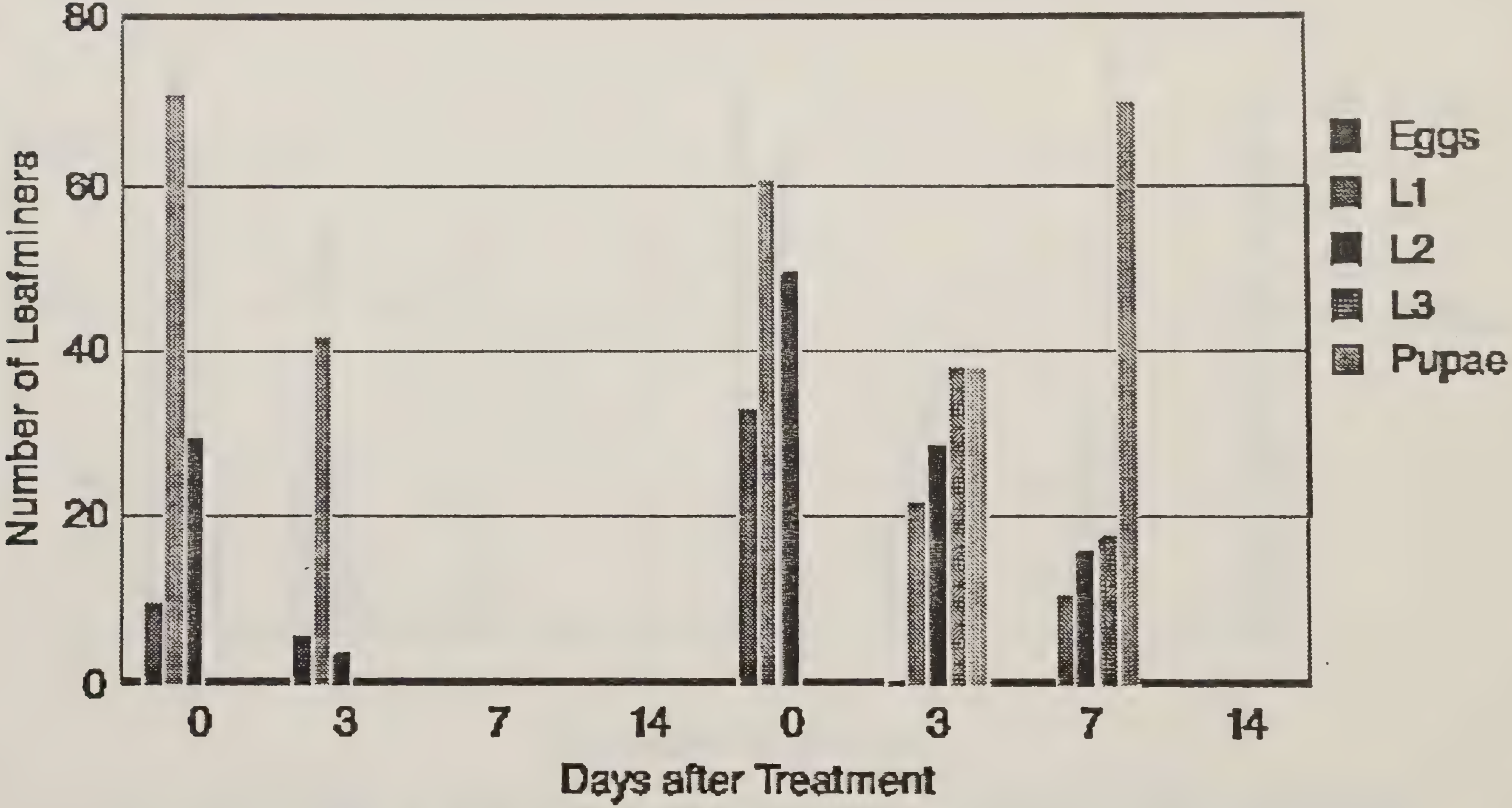

Figure 2. Effect of Agri-Mek (8 ppm) on *L. speculella* development.

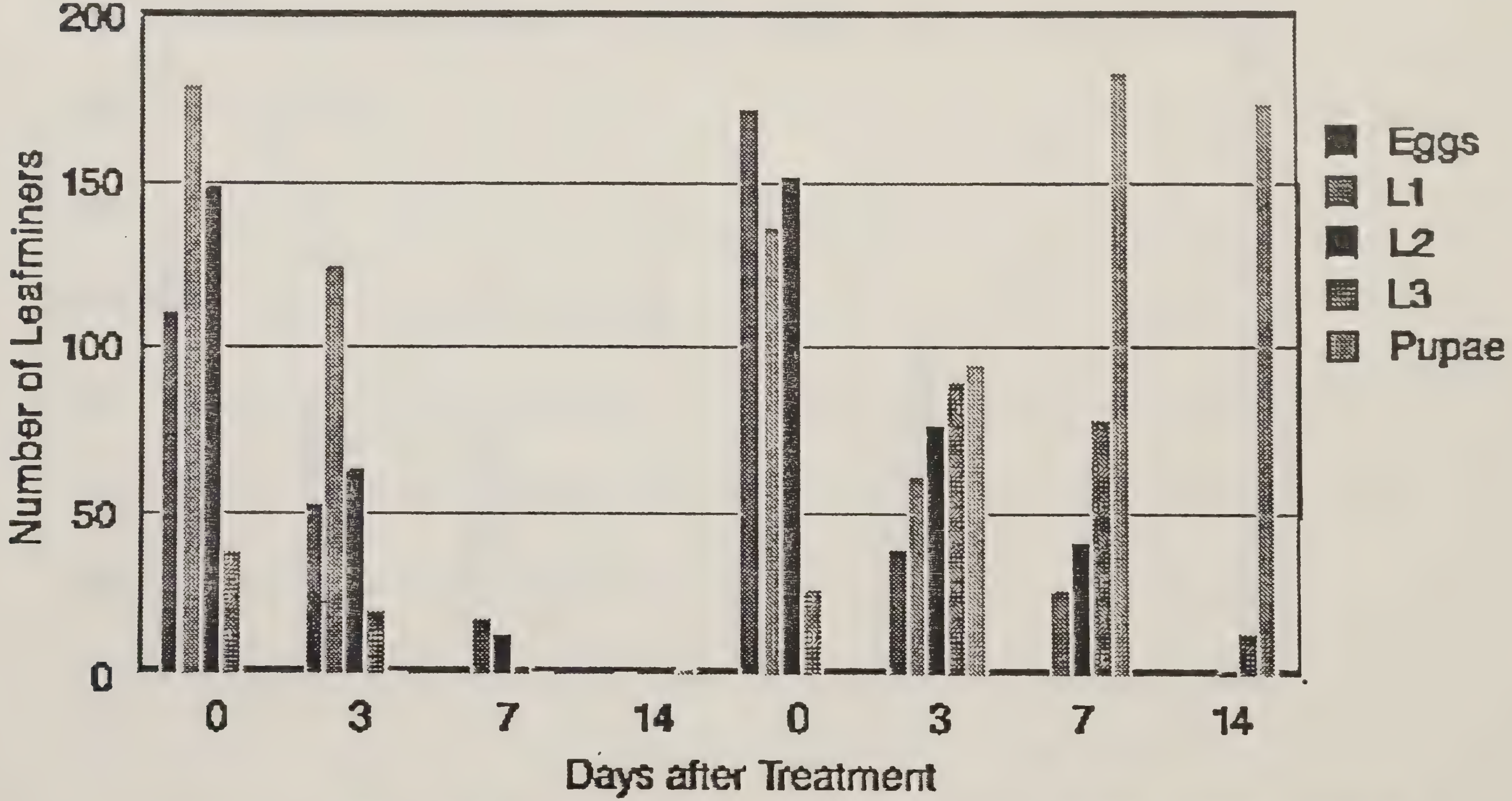

Figure 3. Effect of Agri-Mek (4 ppm) on *L. speculella* development.

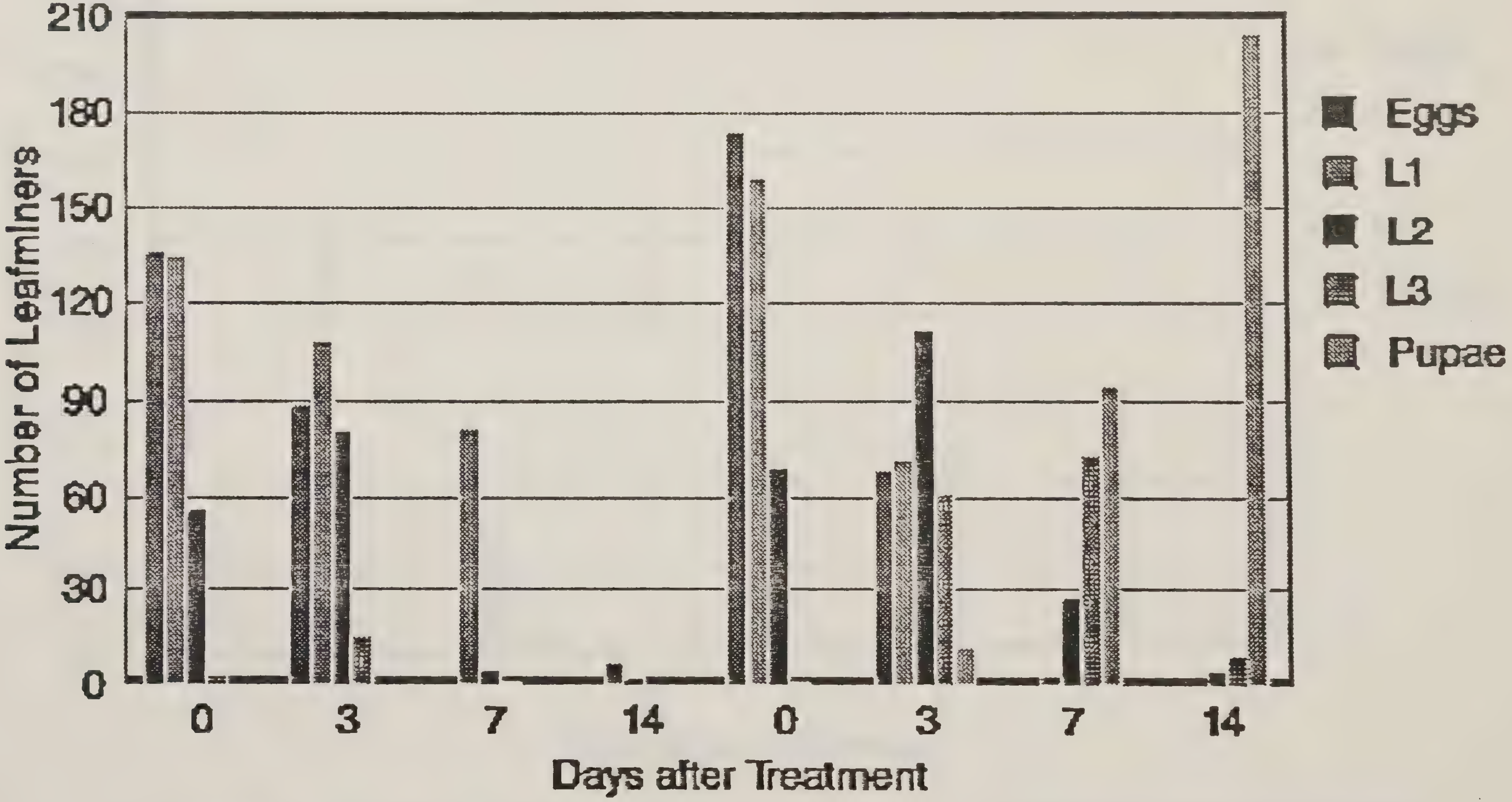

Figure 4. Effect of Agri-Mek (3 ppm) on *L. speculella* development.

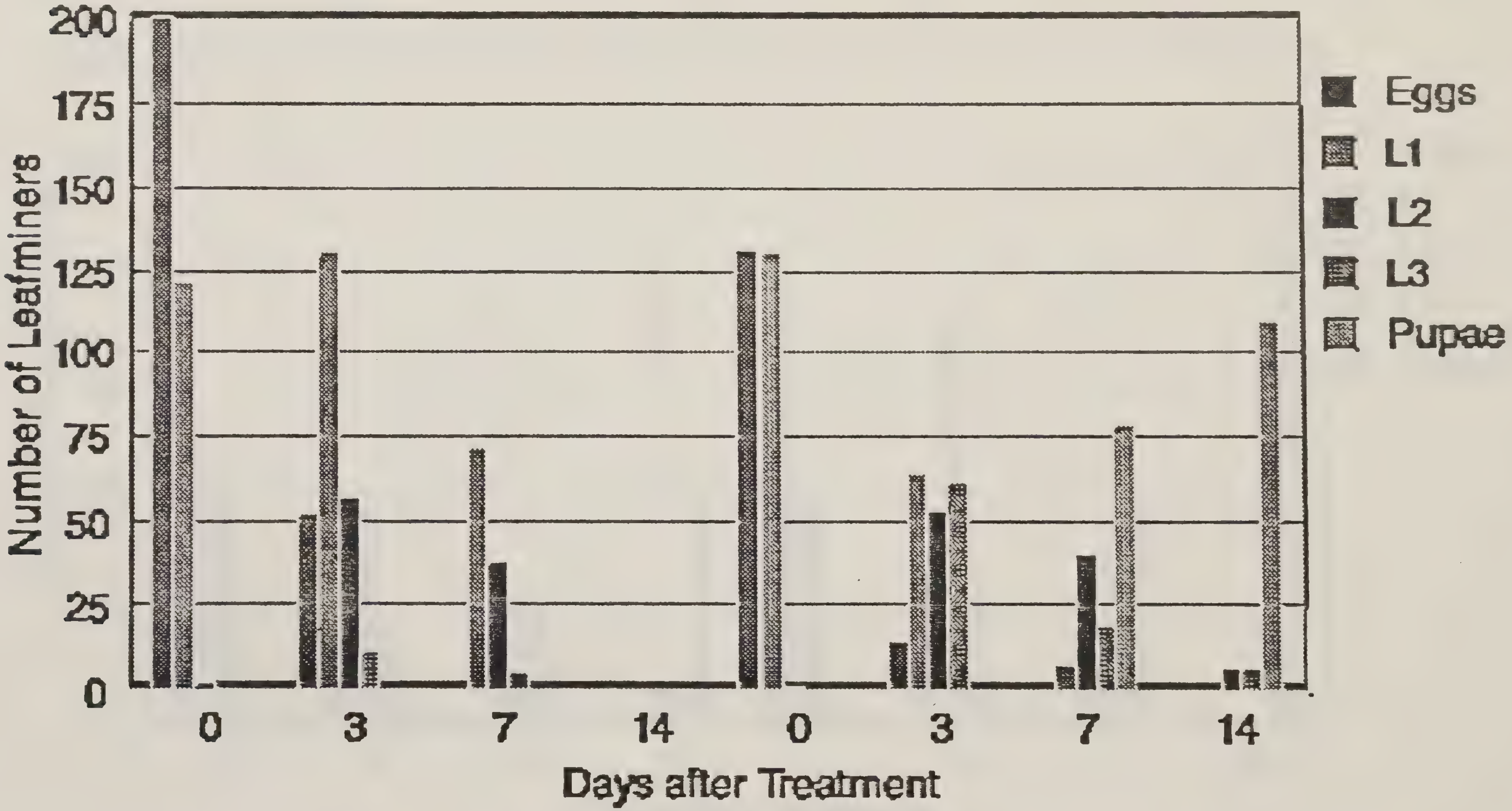

Figure 5. Effect of Agri-Mek (2 ppm) on *L. speculella* development.

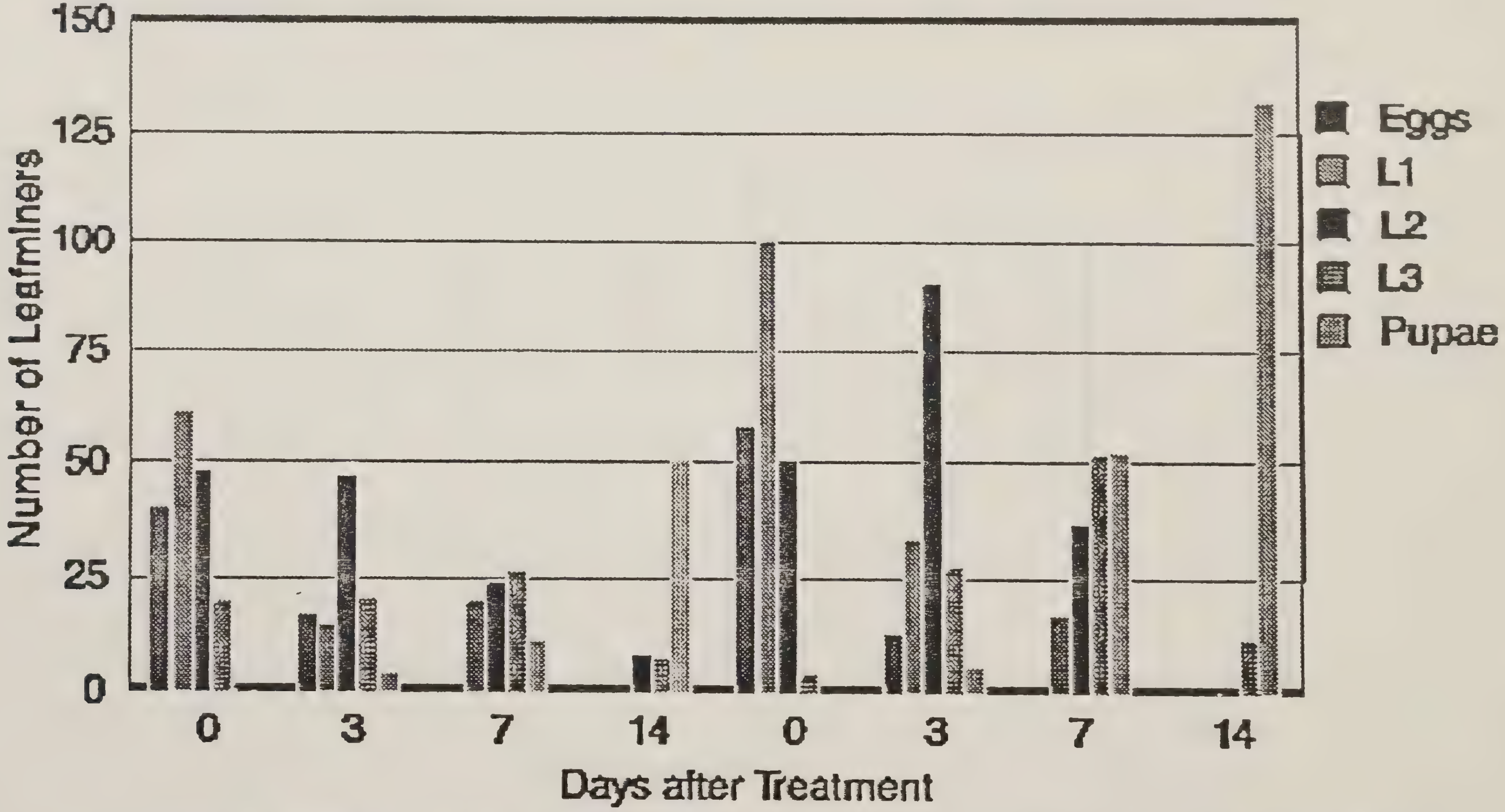

Figure 6. Effect of Agri-Mek (1 ppm) on *L. speculella* development.

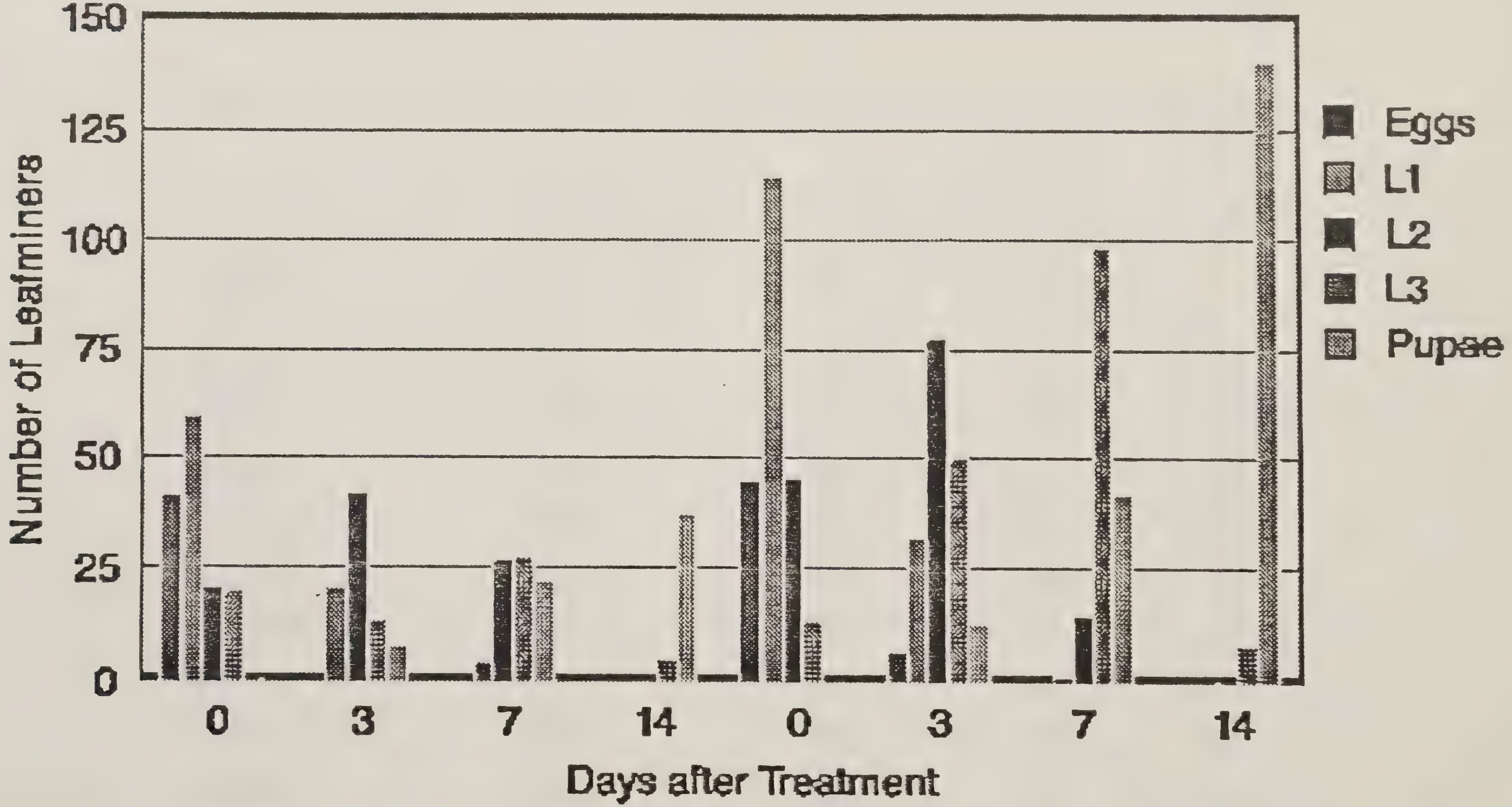

Figure 7. Effect of Agri-Mek (0.5 ppm) on *L. speculella* development.

Table 1. Per cent mortality of *L. speculella* post-treatment with Agri-Mek.

		% Mortality		
Treatment	No. of Leafminers	2-5 days	7-10 days	14 days
16 ppm	161	59	100	
Control	157	11	24	
8 ppm	111	53	100	
Control	144	11	20	
4 ppm	478	45	93	99
Control	475	23	30	31
3 ppm	330	11	72	97
Control	404	20	42	45
2 ppm	317	21	63	100
Control	264	27	45	56
1 ppm	173	38	52	59
Control	215	20	23	26
0.5 ppm	143	39	44	70
Control	220	23	27	31

Table 2. LC_{50} and LC_{95} estimates of Agri-Mek on *L. speculella*.

Days (post-treatment)	LC_{50} (ppm)	LC_{95} (ppm)
2 - 5	14.71	137.62
7 - 10	1.48	7.30
14	0.79	2.51